

The Duluth Complex is not a single layered igneous intrusion, e.g., the Bushveld of South Africa; rather, it is a composite mass of smaller intrusions all closely related in space and time that were emplaced into the basal section of comagmatic volcanic rocks of the rift. The currently known deposits occur in three crudely layered intrusions, the South Kawishiwi, Partridge River, and Bathub. With the exception of the South Filson Creek deposit, major deposit areas (currently eleven) occur in these intrusions within 500 meters of the basal contact with Paleoproterozoic sedimentary rocks and Archean granites (Fig.1). The South Filson Creek deposit appears to be a later stage mineralizing event and is generally above the basal zone.

The known Duluth Complex deposits have been estimated to contain over 4 billion tons of copper-nickel ores with co-product PGE, Au, and Co.



History of Exploration

Though occurrences of copper had been noted in earlier years, serious exploration of Minnesota's copper-nickel resources did not begin until about 1950 following the discovery of mineralization during the blasting of a road cut in the Duluth Complex rocks along the Spruce Road (Fig. 1 inset & Fig. 3). During the ensuing 25 years, considerable exploration was carried out by a number of major mining companies along the basal contact of the Complex. Over 2,000 core holes were drilled by various explorers, generally close to the basal contact. Most of the deposits known today were identified at that time and considerable work was done to try to develop them.

In 1974, the state instituted a moratorium on further leasing, and a generic environmental impact statement on copper-nickel mining and processing. This moratorium lasted until 1980. After removal of the moratorium, some renewed work was carried on, mainly by AMAX. However, declining copper prices and the failure of conventional flotation processes, i.e. to be able to produce a suitably high-grade bulk concentrate or satisfactorily clean separate copper and nickel concentrates, prevented the production of an economically acceptable product for conventional smelting. During all of this period, the generally low-grade PGE values were ignored because analytical techniques were difficult and only reported total PGE values.

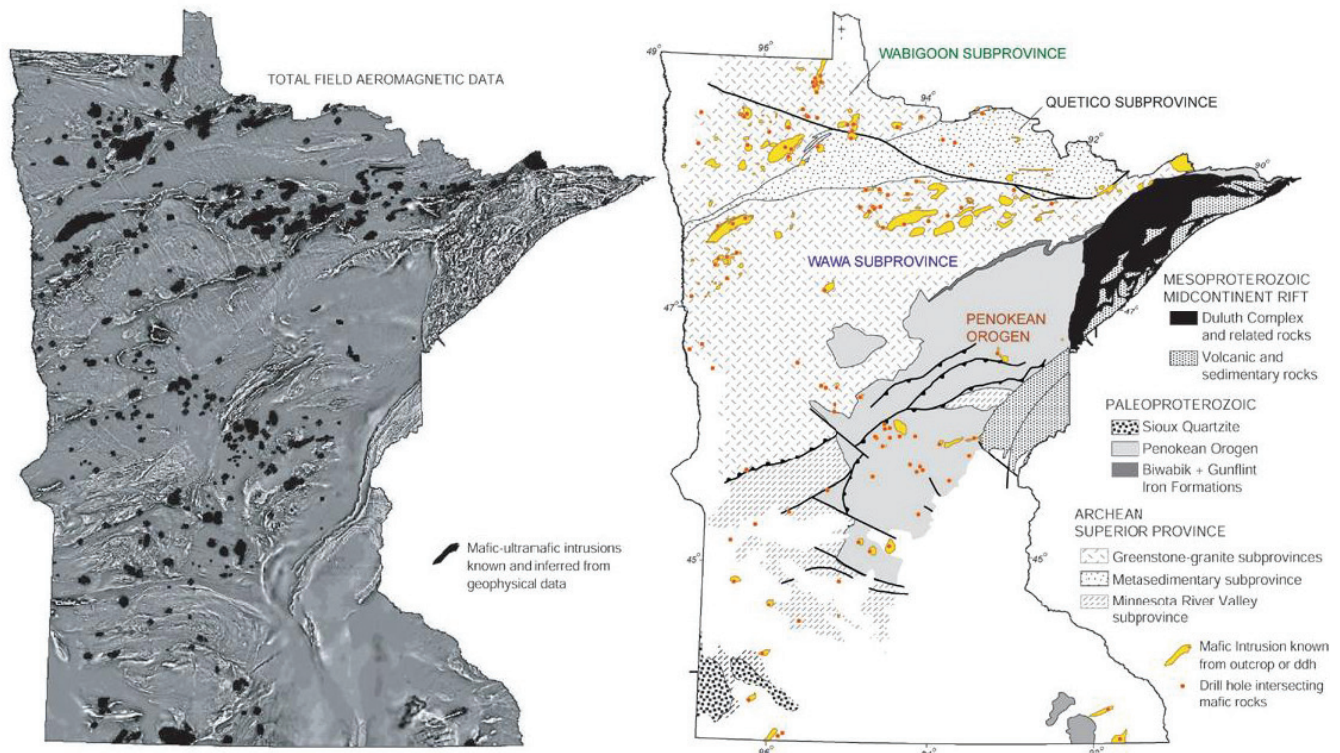


Fig. 2 Statewide aeromagnetic map showing basic intrusions and a generalized geological map (on right) also showing the basic intrusions.

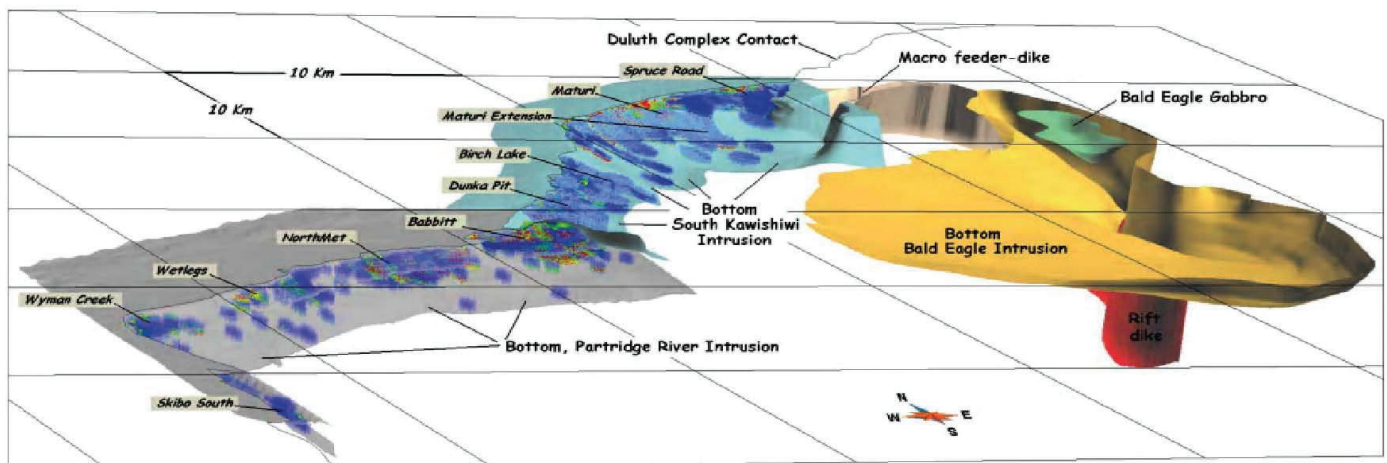


Fig. 3 Active Cu-Ni-PGE projects.

Discovering Significant PGEs

In 1985, the Minerals Division (now Lands and Minerals Division) of the state's Department of Natural Resources undertook a program of assaying old drill cores for vanadium, chromium, and PGEs. In the course of this sampling, a seven-foot zone of significant PGEs was discovered in one hole drilled by Duval in the 1970s. This announcement and rising interest in PGEs for catalytic converters triggered a short period of PGE exploration, but since the PGEs were associated with copper and nickel, the metallurgical puzzle remained. PGEs now added possible value not previously recognized to the deposits.

Solving the Metallurgical Puzzle

In the mid-1990s, solutions for the metallurgical puzzle began to appear on the horizon as hydrometallurgical processes advanced. Work by Teck Ltd. in Vancouver, B.C., resulted in the development of CESL, a proprietary pressure oxidation leach plus SXEW process that can extract the Cu, Ni, and Co from a bulk flotation concentrate. It was tested on the Mesaba (Babbitt) deposit ores and has been recently pilot plant tested in Brazil. A second proprietary process, PlatSol™, which extracts both the base and precious metals, has been developed in conjunction with PolyMet's exploration and development of the NorthMet (Dunka Road) deposit. It has been pilot plant tested on Minnesota's ore deposits, as has Teck's CESL process.

With the key metallurgical puzzle now apparently solved, the door is open to economic development.

Active Cu-Ni±PGE Projects

PolyMet Mining

PolyMet, (NYSE-AMEX: PLM and TSX: POM), completed a feasibility study in 2006 and is working towards obtaining permits to develop the NorthMet deposit as a 32,000 tpd open pit with approximately a 1.4:1 life-of-mine stripping ratio. The NorthMet reserve is 274.6 million tons proven and probable at 0.30% Cu, 0.08% Ni, 73 ppm Co, and 0.37 ppm Pt + Pd + Au. Overall, the defined resource is 694 million tons measured and indicated at 0.27% Cu, 0.08% Ni, 71 ppm Co, and 0.34 ppm Pt + Pd + Au, plus 230 million tons inferred at 0.27% Cu, 0.08% Ni, 56 ppm Co, and 0.37 ppm Pt + Pd + Au. The company has ownership of the former LTV taconite processing plant, tailings ponds, and associated infrastructure. PolyMet plans a mix of hydrometallurgical processing and concentrate sales. An agreement is in place with Glencore to purchase product from the project.

The supplemental draft EIS is in preparation for an expected spring 2013 release for comments.

Twin Metals Minnesota, LLC

Twin Metals Minnesota, LLC, is a joint venture company formed to pursue the development and operation of an underground copper, nickel, platinum, palladium, and gold mining project in northeast Minnesota. The company is 60 percent owned by Duluth Metals Limited and 40 percent by Antofagasta PLC, with offices in St. Paul, Ely and Babbitt, MN.

In February 2011, Twin Metals Minnesota acquired Franconia Minerals Corporation, effectively doubling Twin Metal Minnesota's mineral and land assets, providing the opportunity for greater efficiency and maximum environmental protection for the project.

In October 2011, Twin Metals Minnesota launched the project's prefeasibility study (PFS), which is anticipated to last until sometime in 2014. The PFS will evaluate all project details, including environmental impacts and specific environmental protection controls, mine design, facility siting, transmission, and transportation corridors and the mine's economic impacts. Once completed, the PFS will provide multiple state and federal agencies the information needed to conduct a rigorous and thorough environmental review of the proposed plan.

Twin Metals Minnesota has approximately 32,000 acres of property interest - leased, permitted or owned - on the northern edge of Minnesota's Iron Range. Babbitt, MN is roughly 10 miles to the west and Ely, MN is roughly 15 miles to the northwest. Twin Metals Minnesota's property interest include four NI 43-101 mineral deposits: Nokomis, Maturi, Spruce Road and Birch Lake. These deposits are part of the larger Duluth Complex of copper, nickel and platinum group strategic metals deposits stretching across northern Minnesota.

Teck American

Teck American, a subsidiary of Teck Ltd., holds leases on the largest known deposit in the belt, the Mesaba (or Babbitt) deposit, which lies between the NorthMet and Birch Lake deposits. The CESL hydrometallurgical process was developed to treat ores that are not amenable to conventional concentration and pyrometallurgical processing such as those from the Duluth Complex. In 2008-09, the company collected a new bulk sample and did CESL testwork on concentrates produced at NRRRI's Coleraine Minerals Research Laboratory in Coleraine, MN. The deposit is historically reported to contain about 800 million tonnes of open pit ore with 0.43% Cu and 0.11% Ni plus a small amount of Au and PGEs, and also about 400 million tonnes of underground ore with a grade of 0.84% Cu and 0.19% Ni.

Infrastructure

Minnesota is a mining state. It hosts about 75 percent of the U.S. domestic iron ore production, that has been mined here for well over 120 years. Its iron (taconite) mines annually move on the order of 240 million tons of material per year to produce about 40 million tons of high-grade iron pellets. As a result, there is skilled mining labor and the needed suppliers of mining goods and services. Minnesota has four deep-water ports on Lake Superior, providing access to world markets. Power lines, railways, and highways reach most areas. A high standard of education is accessible to employees.

Land and Mineral Ownership

The right to explore and mine a property is obtained by leasing the mineral rights for a parcel. Mineral ownership may be held by the state, the federal government, private individuals or corporations. The state is the largest owner of mineral rights, holding about 12 million acres or 20% of the total state land area. It has in place a system of leasing of state minerals for exploration and mining. The federal government also holds a large acreage of surface and minerals, mainly in the northeast and north central part of the state. An exploration or mining company can obtain mineral leases directly or there are businesses that will provide the service to assist in obtaining mineral leases.

Taxation

The state of Minnesota levies two taxes specific to non-ferrous mineral production: an "Occupation Tax" that is essentially the same as the corporate income tax and has an effective rate of 2.45% of taxable income after depreciation and depletion. The second tax is a 2% "Net Proceeds Tax" that is levied on income before interest, depreciation, depletion, and royalties. It is in lieu of an *ad valorem* tax on ore reserves. Most mining equipment is exempt from the sales tax. The county and municipality levy an *ad valorem* tax on buildings, but there is no personal property tax on mining or processing equipment.

Regulation and Permitting

The two principal regulatory and permitting authorities are the state's Department of Natural Resources and the Pollution Control Agency. Exploration drilling requires only notice to the Department of Natural Resources and the state Department of Health.

Rules for permitting non-ferrous mining operations have been in place for over 15 years. For commercial operations, the rules require a mandatory Environmental Impact Statement before the approval of any permits. The major issues will generally relate to water, sulfide-bearing mine wastes, and, in some cases, air emissions. A high level of environmental standards is desired by the state, and the history of the mining industry in Minnesota demonstrates that conditions can be satisfactorily met.

For more information, contact:

Jess Richards, Director

Division of Lands and Minerals
Minnesota Department of Natural Resources
(651) 259-5379
jess.richards@state.mn.us

Harvey Thorleifson, Director

Minnesota Geological Survey
(612) 627-4780 ext. 224
thorleif@umn.edu

Brian Hiti, Mining Coordinator

Iron Range Resources and Rehabilitation Board
(218) 735-3017
brian.hiti@state.mn.us

Dan Jordan, Mining and Minerals Program Supervisor

Iron Range Resources and Rehabilitation Board
(218) 254-7007
dan.jordan@state.mn.us

Frank Ongaro, Executive Director

MiningMinnesota
(218) 728-4516
fongaro@minningminnesota.com

Steven Hauck, Mark Severson

Natural Resources Research Institute
University of Minnesota, Duluth
(218) 720-4273 shauck@nrri.umn.edu
(218) 720-4239 mseverso@nrri.umn.edu

Eric Wirz, Forest Geologist

USDA Forest Services
(218) 626-4382
ewirz@fs.fed.us

Joe Henderson, State Mining Coordinator

(651) 757-2424
joe.henderson@state.mn.us